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ABSTRACT

The pilot version of the Measurement of Weight Unit of the Money, Measurement and Time Program was tested with 23 higher functioning educable mentally handicapped (EMH) children (5- to 8-year-old) from regular preprimary classes and with 17 lower functioning EMH children 8- to 10-years-old) from special classes. Pre- and posttesting, teacher evaluation forms, and Teacher Review Board meetings provided feedback on the following six aspects of the pilot version: need for instruction, instructional effectiveness, design of materials, content, sequencing, and test instruments. Revisions in the design, content, and sequencing of the Weight Unit, and the accompanying tests, grew directly out of the formative evaluation plan of the Weight Unit. The value of this step in the overall evaluation plan of the Vocabulary Development Project was confirmed by the relatively final form of the Measurement of Weight Unit which resulted. (GW)

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# MEASUREMENT OF WEIGHT UNIT: A FORMATIVE EVALUATION[1]

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**RESEARCH, DEVELOPMENT AND DEMONSTRATION CENTER IN EDUCATION OF HANDICAPPED CHILDREN**

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The University of Minnesota Research, Development and Demonstration Center in Education of Handicapped Children has been established to concentrate on intervention strategies and materials which develop and improve language and communication skills in young handicapped children.

The long term objective of the Center is to improve the language and communication abilities of handicapped children by means of identification of linguistically and potentially linguistically handicapped children, development and evaluation of intervention strategies with young handicapped children and dissemination of findings and products of benefit to young handicapped children.

# MEASUREMENT OF WEIGHT UNIT: A FORMATIVE EVALUATION[1]

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The Measurement of Weight Unit is one of the five instructional units in the Money, Measurement and Time Program (Thurlow, Taylor, & Turnure, 1973) produced by the Vocabulary Development Project. This instructional unit was developed jointly by educational practitioners and educational researchers to provide educationally handicapped children with an understanding of weight and its measurement. The Unit was first produced in an experimental form which was subjected to extensive evaluation and revision. This process resulted in a product that has been demonstrated to be easily implemented and highly effective for educable mentally retarded (EMR) children (Krus, Thurlow, Taylor, & Turnure, 1974).

This paper is a description of the evaluation of the pilot-test version of the Measurement of Weight Unit. In the Project's four-stage overall evaluation design (Krus, Taylor, Thurlow, Turnure, & Howe, 1974), the evaluation of the pilot-test version represented Stage Three, and was referred to as the "formative" evaluation of the Measurement of Weight Unit. The major purpose of the formative evaluation was to provide a systematic basis for the revision of the Weight Unit. The formative evaluation represented the assessment of the product during its development and involved the

evaluation of its effectiveness and useability in the classroom, feedback to the developers, and subsequent changes in the materials based upon the feedback information. Data obtained during this formative evaluation stage are included here, with a description of the resultant changes in the Measurement of Weight Unit.

## Background of the Measurement of Weight Unit

A search of the available curriculum materials for teaching weight-related skills and vocabulary indicated that available materials were geared primarily for children of normal intelligence, or for children with entry level skills (e.g., reading and/or counting skills) exceeding those of most EMR children of elementary school age. Based upon the evident lack of instruction, and several teachers' interest in providing instruction, the specific weight-related needs of EMR children were assessed and organized into an instructional package consistent with a verbal elaboration-based instructional approach found to be successful with EMR children (Taylor, Thurlow, & Turnure, 1974). This phase of research to development was discussed by Thurlow, Taylor, and Turnure (1973).

## Description of the Measurement of Weight Unit

During the formative evaluation stage, the Measurement of Weight Unit was divided into two levels of instruction: pre-primary and primary. These levels corresponded to the "defined" school system grouping of EMR classrooms. Both the pre-primary and primary books were composed of four lessons. Basically, the four lessons in the

pre-primary instruction provided the students with an introduction to the basic comparatives of weight (heavy, heavier, etc.) and two basic tools for measuring weight (balance and scale).

The first lesson in the primary edition reviewed the two tools for measuring weight that were presented in the pre-primary book. The remaining lessons dealt with the concepts of weight and weighing and presented three standard units of weight -- pounds, ounces, and tons. (See Appendix 1 for a list of the specific lessons in each book.)

The instructional materials in the Measurement of Weight Unit included teacher's editions (pre-primary and primary), cassette tapes containing definitions and stories related to important weight concepts (4 pre-primary; 4 primary), an individual book of pictures for each student to follow as the tape was presented, and numerous worksheets to complete the instruction. A more complete description of the materials (and the underlying instructional techniques) used during the formative evaluation may be found in Taylor, Thurlow, and Turnure (1973).

## Method

### Subjects

Subjects from two pre-primary classes (N = 23) from "neighborhood" schools and two classes (N = 17) from "special" schools participated in the formative evaluation of the pre-primary level of instruction. Subjects from two primary "neighborhood" classes (N = 22) and two "special" school classes (N = 19) participated in the evaluation of the primary level of instruction. As defined by

the school system from which the classes were obtained, children in pre-primary classes were approximately 5 to 8 years of age and children in primary classes were approximately 8 to 10 years of age.

Children in the special classes within the "neighborhood" schools generally represented a higher functioning EMR population (i.e., those children whom it was hoped might be able to return to a "regular" class). "Special" schools were those which contained only classes for mentally retarded children. EMR children in these schools included the lower range of the population who, because of their lower functioning and associated problems, were considered less likely to return to a "regular" class.

Unfortunately, only limited data were collected on the subjects participating in the formative evaluation of the Measurement of Weight Unit. The pre-primary children from the "neighborhood" schools in this study (referred to as Schools 1 and 2) had an IQ range of 60 to 83 ($\overline{X}$ = 7.15, $\underline{SD}$ = 5.6) and an age range of 6.0 to 9.2 years ($\overline{X}$ = 8.2, $\underline{SD}$ = 1.0). Data were not available for the children in the "special" school classes participating in this study. Generally, however, the IQ range of children in such classes is from 50 to 65 (cf., Thurlow, Taylor, & Turnure, 1974b).

IQ and age range data were available from only one of the two primary "neighborhood" school classes. The IQ range was 62 to 96 ($\overline{X}$ = 77.0, SD = 12.3) and the age range was 6.8 to 8.8 years ($\overline{X}$ = 7.8, $\underline{SD}$ = 0.5). Data were not obtained for any children in the primary level "special" school class (School 3 and School 4).

Procedure

As prescribed in the formative evaluation design (Krus, et al., 1974), feedback from the pilot-testing of the instructional materials was looped back to the developers for revision of the materials. The feedback information was obtained in a variety of ways.

First, pretesting and posttesting was conducted to obtain feedback on the effectiveness of the instruction. For speed and convenience to the participating classes, all evaluation testing was done in the form of group-administered tests. Generally, all behaviors that could be tested at a low recognition level were tested prior to instruction; posttesting on the same objectives was conducted after instruction. (See Appendix 2 for a copy of the test questions used.)

Since evaluation at the recognition level could not offer a complete indication of the student's performance, representative behaviors were identified from each of the lessons for teachers to observe and evaluate. The specific behaviors were placed in a "behavioral checklist" and each teacher was asked to note whether or not each child had demonstrated mastery during the instruction. (See Appendix 3 for copies of the behavioral checklists.)

A Teacher Review Board made up of the teachers using the materials during the formative evaluation stage was an important source of feedback for revision. Throughout the formative stage, teachers completed written evaluations of each lesson. (See Appendix 4 for a sample evaluation form.) Teachers also participated in a "Teacher Review Board" meeting when all instruction was completed. Separate

Teacher Review Board meetings were held for the pre-primary and primary levels of instruction, and each involved a three-hour discussion of all instruction, including sequencing, pictures, and any problems not covered by the evaluation forms.

Information from classroom observations was another source of feedback for revision. Since the tape presentations were designed to build vocabulary skills, observations were made primarily on this part of the instruction. Special attention was given to the use of the materials by the teachers, and the response of the students to the tape presentation (e.g., whether or not they answered questions, gestured appropriately, etc.). As will be brought out in the discussion of this paper, systematic use was not made of the classroom observations; it was not until the formative evaluation of the Money Unit that a recording system for observations was developed (Thurlow, Krus, Howe, Taylor, & Turnure, 1974a). Therefore, feedback from observations was actually at a general "impression" level. Observations were made primarily by the chief developer of the Unit, and then discussed at the Teacher Review Board meeting. Because of the subjective nature of the classroom observation data, it is not included as a separate summary in the results section of this paper. Implications for revisions obtained from the classroom observations, however, are included within the summary of the Teacher Review Board Meeting.

## Results

A summary of the revision information obtained from each of the sources of feedback is included here. All information obtained from

the formative evaluation of the pre-primary level of the Measurement of Weight Unit will be presented first. There is a lesson by lesson description of (1) the objectives tested, and (2) the information obtained from teacher evaluation forms. The description of the objectives includes individual class data from testing completed prior to instruction ("Pre") and following all instruction ("Post"). The formative feedback on the pre-primary level of instruction concludes with a summary of the information obtained at the Teacher Review Board Meeting.

The evaluation of the primary level of the Measurement of Weight Unit is presented next. The format for this section is the same as that of the pre-primary section.

Formative Evaluation of Pre-Primary Weight Unit

Lessons 1 & 2 . . . . . 8

Lesson 3 . . . . . 13

Lesson 4 . . . . . 16

Notes from Teacher Review Board Meeting . . . . . 20

LESSON 1: HEAVY AND LIGHT

LESSON 2: HEAVIEST AND LIGHTEST

A. Objectives

1. Identifies all heavy objects from a set of pictured objects.
2. Identifies all light objects from a set of pictured objects.
3. Identifies the heaviest object from a set of pictured objects.
4. Identifies the lightest object from a set of pictured objects.

B. Performance of classes

| | School 1 | | School 2 | | School 3 | | School 4 | |
|---|---|---|---|---|---|---|---|---|
| | Pre | Post | Pre | Post | Pre | Post | Pre | Post |
| 1. Identifies heavy | 64 | 83 | 33 | 75 | 60 | 75 | 38 | 50 |
| 2. Identifies light | 73 | 100 | 25 | 83 | 100 | 100 | 38 | 25 |
| 3. Identifies heaviest | 64 | 67 | 25 | 75 | 60 | 38 | 25 | 38 |
| 4. Identifies lightest | 27 | 67 | 67 | 58 | 20 | 25 | 13 | 25 |

C. Interpretations

It should be noted initially that the Weight Unit objectives were not easily converted into picture recognition test items. By nature of the words, judgments of "weights" (e.g., what's heavy or what's light) are usually made after one can physically test out the objects; further, the judgments to a certain extent are relative (e.g., what's "heavy" to one person may not be "heavy" to another person).

1. Generally the pretest scores for School 2 and 4 (the younger pre-primary classes) seem to be lower and indicate a need for instruction on "heavy" at the young pre-primary level. Although only one class reached criterion, small gains were shown in all classes. Revision of instruction and/or test item is indicated.
2. As with objective #1, the older pre-primary classes are performing above the younger classes on identification of "light." Criterion was reached in all schools except one where a decrease was shown. Further examination of the class score sheet, testing conditions and/or teacher's comments appears necessary. Otherwise, the instruction on this objective appears adequate.
3. The data on identification of "heaviest" are ungeneralizable. The characteristics of this objective (see comments listed at beginning of section C) may have created this problem. Revisions in instruction and/or test item are indicated.
4. The data from identification of "lightest" are also ungeneralizable. Revisions in the instruction and/or test item are definitely indicated.

Lesson 1 - Heavy and Light

A. Objectives and Materials

1. All felt objective was clearly stated and appropriate for "some" to "most" of the children in class.
2. All felt that "some" of the children had reached the objective before lesson began.
3. All felt the materials (boxes) were very difficult to find; these should either be provided or alternatives suggested.

B. Pre-Activity

1. All felt that "some" to "most" of the children in class needed the pre-activity.
   a. Helpful for those needing it.
   b. Good for those knowing concepts (clarified that biggest isn't always heaviest).
2. Time: 15 - 25 minutes
3. Explanation of activity was felt to be sufficient. (It was suggested, however, that pre-activity would be better if only 2 things were compared, and the activity didn't get into "heaviest" and "lightest".)

C. Tape Presentation

1. All felt the pre-activity had prepared the children for the tape, but it was suggested that the children should be given some time, before the tape begins, to discuss the cover picture and draw some conclusions of their own.
2. Advance Organizer - two of the three teachers were unsure that the children had listened to the advance organizer or that it had prepared them for the lesson.
   Suggestions:
   a. Use of question in advance organizer was very effective.
   b. Tape may have been going too fast during advance organizer.
   c. Children wanted to "talk" about the picture - pre-dicussion about picture would help.
   d. Picture should have shown something "light," as well as something "heavy."
3. Definitions - two of the three teachers felt children had obtained functional definitions for both "heavy" and "light." One felt a functional definition had been obtained for "heavy," but only a rote definition for "light."
4. Elaborations - generally helpful; no specific problems.

5. Time: 15 - 35 minutes.
6. Additional Comments: It was necessary to "really" go over the fact that "heavy" was "hard to lift" and "light" was "easy to carry."

D. Post-Activity

1. It was felt that "most" to "all" of the children needed the post-activity.
   a. Helpful for "most" to "all" of the children needing the activity.
   b. Good for those who didn't need an activity.
2. Time: 10 - 25 minutes

E. General Comments on Lesson

1. Lesson should be first.
2. Objective of lesson was met.
3. Felt "most" to "all" children knew the concepts at end of lesson.
4. Children enjoyed lesson, especially the hunt for heavy and light objects (Post-Activity) and the worksheet (Summary activity).
5. Time: (Length felt to be good; all did one activity per day)
   a. 4 days - 70 minutes
   b. 5 days - 90 minutes
   c. 1 day - 45 minutes

Lesson 2 - Heaviest and Lightest

A. Objective and Materials

1. All felt objective was clearly stated and appropriate for "most" of the children in the class.
2. All felt that "some" of the children had reached the objective before the lesson began.
3. All felt materials were easy to get (although it was noted that cup and plate could be very close in weight, especially when plastic was used).

B. Pre-Activity

1. Two of three teachers agreed that no pre-activity was needed.
2. One teacher was unsure.

C. Tape Presentation

1. Advance Organizer - all were unsure whether children listened to the advance organizer and whether it prepared them for the lesson. (It was suggested that more discussion and guessing which animal in picture was heaviest, which lightest, would be helpful.)
2. Definitions - two of three teachers felt children had obtained functional definitions for both "heaviest" and "lightest"; one felt that no definition was obtained for "lightest."
3. Elaborations - generally helpful
   On elaboration for lightest:
   (1) Plate, spoon, & cup - glass might be better to use than a cup; these things are good because they are part of daily use; one teacher felt different "light" things might be better.
   (2) It might be hardest for kids to understand "lightest" because it is "easiest."
4. Time: 5 minutes; 20 minutes; 60 minutes
5. Additional Comments:
   a. Two of three teachers felt that in places where teacher had to direct activity during tape, there was sufficient explanation sometimes.
   b. Two of three teachers felt that the children did not understand the relationship between the words.
   c. Pictures:
      (1) #1 - some didn't recognize hippo
      (2) Worksheet - man on chair caused problems

D. Post-Activities

1. All felt the post-activities strengthened the concepts taught in the tape.
2. Number of activities was about right, except there might have been another worksheet which could be presented as a quick review the next day.
3. Required Activities
   a. (#1) Good activity, but some children had difficulty with "lightest." Children need to be "made" to use the words over and over (why is it the lightest? It is the lightest because . . .). Good as review of heavy and light.
      Time: 10 - 20 minutes
   b. (#2) Good activity; might have used a worksheet with 4 things - children color heaviest, lightest.
      Time: 10 - 20 minutes
   c. (#3) Good activity, but children had some problems:
      (1) Fat woman was over-represented; children thought she was heavier than the car; some thought car was a toy.
      (2) Children had a lot of trouble finding the "lightest" thing (may have helped to have actual objects to test).

E. General Comments on Lesson

1. All teachers agreed that this lesson should be last, and follow the lesson on heavier and lighter.
2. It was suggested that children be taught concept of "easy, easier, easiest" before receiving this lesson (these are used to define light and lightest).
3. Objective of lesson was met, but was more difficult and confusing without heavier and lighter first.
4. Felt "some" to "most" children knew concepts at end of lesson.
5. Children enjoyed lesson (but had quite a bit of trouble with understanding lightest).
6. Time: (Length felt to be "about right")
   a. 3 days - 60 minutes
   b. 5 days - 180 minutes
   c. 1 day - 35 minutes
   All included one activity per day.

## LESSON 3: HEAVIER AND LIGHTER

A. Objectives

1. Identifies a heavier object when asked to identify the object that is heavier than a specified object.
2. Identifies a lighter object when asked to identify the object that is lighter than a specified object.
3. Identifies an object "as heavy as" a specified object.

B. Performance of classes

| | School 1 | | School 2 | | School 3 | | School 4 | |
|---|---|---|---|---|---|---|---|---|
| | Pre | Post | Pre | Post | Pre | Post | Pre | Post |
| 1. Identifies heavier | 64 | 50 | 58 | 33 | 100 | 63 | 75 | 75 |
| 2. Identifies lighter | 45 | 67 | 33 | 75 | 100 | 100 | 38 | 13 |
| 3. Identifies as heavy as | 45 | 25 | 8 | 33 | 40 | 38 | 25 | 0 |

C. Interpretations

1. Keeping in mind that the children had no way to judge the actual "weights" of the objects, pretest scores would seem to indicate that only minimal instruction on heavier is necessary. Lower posttest scores suggest three major considerations: (1) the test question is unreliable and does not test what it was designed to test, (2) the instruction was inadequate and did not teach the concept of "heavier," (3) the instruction had a negative effect. Revisions are necessary.
2. Need for instruction on identification of lighter was shown in three of the four schools. Since only one of those three increased to near criterion (75%) and another of the classes decreased in performance, revisions of the instruction are indicated. The comments made for objective #1, however, suggest that information obtained from the test question may be unreliable and revision of the item may be necessary.
3. Scores obtained on the objective "as heavy as" were generally low (pretest and posttest). Analysis of the test item indicates that it is a difficult item and combines the problems listed under Lesson 1 interpretations. The general lowering of scores on the posttest seems to indicate that revisions are needed in <u>both</u> the test question and the instruction.

Lesson 3 - Heavier and Lighter

A. Objective and Materials

1. All felt objective was clearly stated and appropriate for "some" to "most" children in class.
2. All felt that "some" of the children had reached the objective before the lesson began.
3. All felt materials were very easy to obtain (should be sure teacher realizes pencil and crayon should be the same size).

B. Pre-Activity -- agree that none was needed.

C. Tape Presentation

1. Advance Organizer - all felt children did listen to this advance organizer and that it did set them up for the lesson.
2. Definitions - obtained functional definitions for "heavier" and "lighter," at least for concrete objects (not necessarily pictures of objects), but only a rote definition of "same as."
3. Elaborations - generally helpful; relation especially good. Need more elaborations on "same as."
4. Time: 20 - 45 minutes

D. Post-Activities

1. All felt the post-activities strengthened the concepts taught in the tape.
2. One teacher suggested sequence of required activities should be changed to 2 - 1 - 3.
3. Required Activities
   a. (#1) Good activity (enjoyable; begins to develop idea of balance); children had some trouble finding things weighing the same.
      Time: 10 - 15 minutes
   b. (#2) Good activity (again, had some trouble finding objects the same weight).
      Time: 10 - 15 minutes
   c. (#3) Idea of activity was very good, but children had several problems with the activity itself.
      (1) It was difficult for children to hold 10 pencils in one hand (concept was lost to amusement of who could hold 10 pencils).
      (2) By adding pencils one at a time, child couldn't feel added weight. Also, there is a problem of having the child's arm out for so long -- things begin feeling heavier due to muscle strain.
      Time: 10 - 15 minutes

4. Optional Activities

(#2) Worksheet was good except for the shirt and shoe -- problems children had indicated they were judging by the size of the objects. Worksheets are important because children can take them home to "show off" what they have learned.

E. General Comments on Lesson

1. Lesson should have been second in unit. Suggested reordering of lessons: Heavy-Light; Heavier-Lighter; Heaviest-Lightest; Same; Balance and Scale.
2. Objective of lesson was met.
3. Felt "most" to "all" children knew concepts at end of lesson.
4. Children enjoyed lesson very much, especially the post-activities.
5. Time: (Length felt to be "about right")
   a. 3 days - 60 minutes
   b. 4 days - 90 minutes
   c. 1 day - 45 minutes (more than one activity per day)
6. Concept of "same" weight was not covered enough.

A. Objectives

1. Identifies balance scale from a set of pictured objects.
2. Identifies a balanced (balance) scale from a set of pictures.
3. Identifies an object (from a set of pictures) that would balance a comb on a balance scale.
4. Identifies the side of a balance scale that is heavier.
5. Identifies a scale when asked, "Find the thing in the bottom of the picture that [the boy] would use to find out how heavy his ball is."
6. Identifies scales from a set of pictures.

B. Performance of classes

| | School 1 | | School 2 | | School 3 | | School 4 | |
|---|---|---|---|---|---|---|---|---|
| | Pre | Post | Pre | Post | Pre | Post | Pre | Post |
| 1. Identifies balance scale | 18 | 42 | 8 | 100 | 40 | -- | 38 | -- |
| 2. Identifies balanced | 45 | 83 | 25 | 92 | 80 | 100 | 50 | 63 |
| 3. Identifies balance | 45 | 58 | 50 | 75 | 30 | 75 | 50 | 63 |
| 4. Identifies heavier | 64 | 92 | 42 | 83 | 60 | 88 | 88 | 50 |
| 5. Identifies scale | 45 | 67 | 25 | 92 | 80 | 88 | 38 | 75 |
| 6. Identifies scales | 64 | 67 | 42 | 83 | 60 | 88 | 63 | 63 |

C. Interpretations

1. Low pretest scores show that instruction is needed at the identification level for "balance scale." Unfortunately, only two of the classes were posttested on this item. Both classes showed an increase, but interestingly, it was the younger class that showed a marked increase and surpassed criterion. Inquires are needed to determine the differences in the instruction between the classes. Based on the gain achieved in the younger class, instruction seemed adequate.
2. Pretest scores below criterion indicate a need for instruction on "balanced." Although only 3 of the 4 classes reached criterion, gainswere satisfactory and instruction seems complete on this objective.
3. This is another test item that exhibits all the problems discussed in the opening "interpretations" comments. Use of an actual balance to demonstrate the skill (balancing a balance scale) would be a more valid type of test question.
4. Pretest scores indicate some instruction is necessary to obtain this objective (identifying the "heavier" side of a balance scale). Posttest scores indicate that a few additional activities are necessary to reinforce this concept (i.e., scores are borderline at criterion level and one school showed a decrease

from an 88% pretest level).

5. Generally low pretest scores indicate that instruction is necessary to relate "scale" to its definition (what is used to find out how heavy things are). With two of the schools reaching criterion and two just below criterion, instruction appears satisfactory. Additional activities, however, should be added to insure 80% to 100% performance.
6. Pretest scores indicated that only minimal instruction is necessary to identify "scales." Lack of increase to criterion level in two classes indicates that additional experiences are necessary, however, for the children to identify various scales (The children were required to identify all 3 scales from a selection of 6 pictures.)

Lesson 4 - Balance and Scale

A. Objective and Materials

1. All felt objective was clearly stated and appropriate for "most" to "all" of children in class.
2. It was felt that "none" to "some" of the children had reached the objective before lesson began.
3. All felt materials need to be provided.

B. Pre-Activity (Structured)

1. All felt activity was appropriately structured.
2. Need for pre-activity varied: some-2, all-1.
   a. Helpful for those needing it.
   b. Good and interesting for all.
3. It was suggested that this activity should be a post-activity, and that there should be an overall review before the lesson.
4. Another suggestion was that the pre-activity was too much of a review; should have more specifically dealt with the balance scale.
5. Time: 20 minutes

C. Tape Presentation

1. Advance Organizer - teachers were unsure as to whether the children attended to advance organizer. It was suggested that there should have been some actual work with the balance (or object similar to balance) to adequately prepare child for lesson.
2. Definitions - two of the three teachers felt that no definition had been obtained for "balance"; one felt the same was true for "scale."
3. Elaborations - generally helpful; one teacher felt elaboration on balance was best; another felt it had to be simple and more concrete for the children.
4. Time: 25 minutes; 120 minutes
5. Additional Comments
   a. One teacher was unsure that the flow from "balance" to "scale" was smooth.
   b. Two of three teachers felt the children did not understand the relationship between the words presented.
   c. One teacher felt picture #1 was inappropriate (too complex).

D. Post-Activities

1. One teacher was unsure as to whether the post-activities strengthened the concepts; other teachers felt the activities did strengthen the concepts taught in the tape.
2. One teacher felt there were too many post-activities. Others felt the number was about right.
3. The best activities would be ones where children actually work with the balance and with the scale.
4. Required Activities
   a. (#1) Good activity because children enjoy having things of their own. Children were able to use balance.
      Time: 45 minutes
   b. (#2) Very difficult. Two suggestions were made:
      (1) Have children actually do this. Don't use a worksheet at all.
      (2) Have pictures of objects for the child to choose from. He would then cut them out and paste them on the scales
      Time: 15 minutes
   c. (#3) One teacher felt activity was especially good for realization of weight, lbs., etc. Another noted difficulties with children sensitive about their own weight (did not do).
   d. (#4) Very good activity; children really enjoyed it. The scale must be relatively good-- a bathroom scale is probably inappropriate. Also, it was felt that it would be very difficult not to mention "pounds" here.
5. Optional Activities
   (#2) It was suggested that this activity would be a perfect pre-activity if a teeter-totter was available.

E. General Comments on Lesson

1. Teachers felt the children should have had a pre-activity dealing specifically with the balance and scale before this lesson.
2. Tape was too fast - had to talk over definitions for children.
3. Felt "some" to "most" knew concepts at end of lesson.
4. Children enjoyed the lesson, especially working with the balance. The tape presentation was difficult because it was too fast, and required a lot of stopping.
5. Time: (length felt to be about right)
   a. 5 days - 150 minutes
   b. 8 days - 300 minutes
   Lesson seemed longer, but needed to be so because concepts were difficult.

Comments on Unit as a Whole 

A. Ordering of Lessons in Pre-Primary Weight Unit

1. All had problems with ordering as is -- it was too difficult to get at "heaviest" and "lightest" before "heavier" and "lighter" ("heaviest" and "lightest" compare too many things and actually depend upon "heavier" and "lighter").
2. All felt "as heavy as" was treated too lightly. (Phrase itself is very difficult to get children to say; should start with "same" / "the same as"/ "as heavy as").
3. SUGGESTED RE-ORDERING:
   a. Heavy - Light
   b. Heavier - Lighter
   c. "The Same"
   d. Balance (either here or after heaviest - lightest)
   e. Heaviest - Lightest
   f. Scale

B. Advance Organizers

1. It might be most effective if the teacher gave the advance organizer herself.
2. Some of the cover pictures were too cute - and kids didn't have a chance to look at the picture before tape began.
3. Conclusion: Should have both the teacher and the tape give an advance organizer.
   a. Give teacher an outline suggesting review and advance organizer (relating to picture).
   b. Tape would then reinforce organization already given by the teacher.

C. Design of Materials

1. Structure changes - it might be good to have a "Materials Needed" section at the beginning of the whole unit.
2. Difficulties with tape mode:
   a. Need more stop tapes - almost after every page.
   b. Need to loosen tapes up (e.g., Hi! I'm Mr. Tape Recorder...)
   c. It is very difficult to stop the tape in the middle of a page.
      (1) Have simple pointing, naming, etc., but have a set break at the end of a page where the teacher could review a definition or elaboration.
      (2) If this was done, teacher would have the kids turn the page and let them look at the picture, etc., before the tape begins.
   d. Pauses were generally not long enough.
3. The format for all of the weight lessons (except 4) was the same; this similarity in format may have confused the kids because the words were so similar.

Comments on Lessons

A. Lesson 1 - Heavy and Light

1. Introduction: Materials (boxes) were hard to get. The suggestion may have been too specific. Include a more general suggestion of possible things to use (other alternatives).
2. Pre-Activity
   a. Too inclusive; actually takes kids in wrong direction - they end up looking for small comparisons between heavy and light things.
   b. Suggestion: Have brief activity which compares only heavy and light and which stresses actual comparison of objects very different in weight.
3. Tape Presentation
   a. Advance Organizer - picture needs to get at both concepts (heavy; light), and should show boy not able to lift heavy thing.
   b. Direction: Lesson should start with the comparison idea, not with a group of heavy things then a group of light things.
   c. Definition (Heavy): puts too much stress on "it's heavy because it's hard to lift"; its a good definition, but it is too prevalent.
      Problem: Different kids had different criteria - little kids felt something was heavy, bigger kids didn't.
   d. "Light" - kids understood concept, but had trouble using the word "light" (would say "not heavy" or "one is heavy").
   e. Summary - worksheet was very good here.
      (There were problems later, however: (1) Doll and glass were hard to distinguish; (2) It was hard to keep the worksheets around. Would suggest this worksheet be used here, and replaced with another later.)
4. Post-activity - very good: however, this was the point at which the children got into competition about who could lift things.

B. Lesson 2 - Heavier and Lighter

1. Pre-Activity
   a. This lesson should have a pre-activity, if the pre-activity for Lesson 1 is reduced to one on just "heavy" and "light."
   b. Pre-activities are best if kids actually do something - have the kids actually lift objects and discuss.
2. Tape Presentation
   a. Cover picture - good idea, but the two animals look like they weigh the same - should be very different in weight (reflected in arm position) to get at concept.
   b. Heavy - Light - kids have problems going from a picture to a real object; it would help to start with objects (pictures of them) that are easy to distinguish (and try to do in head since we can't always lift things).
      NOTE: It is very important to get kids to use these and other words in sentences. Unit may not have done this enough.

c. The Same
   (1) Kids had trouble with picture - they didn't think things were the same (in many cases, this was true).
   (2) It may help to start with two objects that are exactly alike, then move to other objects. Other objects should be suggested.
   (3) All think this should be a lesson by itself.

3. "Easy, Easier, Easiest"
   a. These words were not taught, but the definitions for "light," "lighter," and "lightest" were based on these concepts. All agreed that we cannot assume these concepts.
   b. Suggestion: Develop the meaning of these concepts in the pre-activity with each set of words.
   For example, when introducing "heavy" and "light," use two objects very different in weight. With heavy object - introduce it as being hard to lift. With light object - introduce it as being easy to lift. Use these words a number of times in the pre-activity so children are familiar with the words and the meaning we are giving to them.

4. Post-Activities
   a. Generally the activities were good.
   b. The worksheet created problems (snake and worm; shoe and shirt).
      (1) It was felt that if the kids were to judge only from pictures, the things pictured should be more contrasting in weight.
      (2) It might be best to have things in the worksheet that the kids could check out first, and then decide which was heavier and which was lighter.
      (3) The coloring idea was very hard for the children - they couldn't remember what color was to be used to do each thing; ended up finding all heavier objects first and coloring them, then finding all lighter objects and coloring them.
      (Teachers did like the coloring idea).

C. Lesson 3 - Heaviest

1. Pre-Activity
   a. Again, teachers felt this lesson should have a pre-activity to get at just heaviest and lightest.
   b. It was suggested that the pre-activity might use the cover picture. Review ideas of heavier and lighter comparing all animals, and get at which one would be hardest to lift; which one would be easiest to lift?

2. Tape Presentation
   a. Had a number of picture problems here:
      (1) p. 1 - many didn't know the "hippo"
      (2) p. 2 - these weren't good materials; in many cases it was very difficult to tell the difference between the cup and the saucer. Suggested we use materials that are in the classroom. (Maybe have this worksheet be a take home one for kids to work on.)
   b. Lesson should get at finding the lightest thing in any set of objects (including all heavy objects) as well as finding the lightest thing in a set of light objects.
   c. We might want to have a note saying that "lightest" cannot be fully understood here, and that further understanding will be developed in the post-activities.
   d. Review of definitions is very important, not only in this lesson, but in all lessons. We may want to have a note at the end of the tape reminding the teacher to review all definitions (may also want before each lesson in teacher's advance organizer).
   e. Summary worksheet did not work here. It might be best to have a summary here which gets at the comparison of all objects (as was suggested for advance organizer picture).
3. Post-Activities
   a. #1 - instructions are too loose ("finding as many heavy things ..."); give a specific number (e.g., find 5 things).
   b. #2 - more of this should be in the tape lesson; would like to see a worksheet added.
   c. #3 - many picture problems here
      a. It might help to have a worksheet in which all things to be compared are in one picture (so kids can tell they are real).
      b. Also, it might be good to have the kids look out the window and compare the weights of objects they see.

D. Lesson 4 - Balance and Scale

1. Pre-Activity
   a. The given pre-activity is a good review and should be after the other lessons as a review. But, it doesn't introduce this lesson. It would introduce a balance. (Maybe work from objects that weigh the same to measuring device that shows us they do weigh the same.)
   b. The pre-activity should use a balance, but not actually get at the word.
2. Tape Presentation
   a. Would like to see the ordering of the definitions under balance different (introduce noun first, then the verb).
   b. Scales - the picture for the truck scale was very difficult for many (may need to exaggerate it for kids). A baby scale would be another good example.

3. Post-Activities

a. As a math extension, might suggest the teachers use a number balance.
b. Teachers would like to see work with the scale taken a little further in the post-activities. (Have kid compare objects, then balance, then actually weigh on a scale - with the teacher doing the weighing.)
c. (#2) - good idea, but kids had trouble thinking of things to put on scale; or in many cases, any objects the same size were taken to balance the scale, etc.
   Suggestion: Make this a 4-step structured activity
   a. Have kids get two objects (from a specific set)
   b. Then, have kids guess which is heavier,
   c. Then, have weights checked on scale for confirmation by teacher,
   d. Then, have kids record on balances.
d. (#1) - make optional
e. (#3) - This, perhaps, should be optional. It might help to limit the comparisons to 5 children.
f. Might also use a ruler and pencil to get at the idea of "balance."
g. None of the optional activities were used.

Formative Evaluation of Primary Weight Unit

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# LESSON 1: BALANCE AND SCALE

A. Objectives

1. Identifies all heavy things from a set of pictured objects.
2. Identifies the object that is heavier than a specific object.
3. Identifies the heaviest object from a set of pictured objects.
4. Identifies "scale" when asked: "Find the thing in the bottom of the picture that the boy should use to find out how heavy his ball is."
5. Identifies various "scales" from a set of scales and distractors.
6. Identifies "balance scale" from a set of pictures.
7. Identifies a "balanced" scale from a set of pictures.
8. Identifies an object that would "balance" a scale.

B. Performance of classes

| | School 1 | | School 2 | | School 3 | | School 4 | |
|---|---|---|---|---|---|---|---|---|
| | Pre | Post | Pre | Post | Pre | Post | Pre | Post |
| 1. Identifies heavy | 55 | 50 | 100 | 92 | 60 | 75 | 78 | 78 |
| 2. Identifies heavier | 64 | 67 | 50 | 50 | 60 | 75 | 89 | 67 |
| 3. Identifies heaviest | 82 | 75 | 40 | 42 | 50 | 50 | 44 | 56 |
| 4. Identifies scale | 64 | 83 | 50 | 92 | 80 | 88 | 56 | 78 |
| 5. Identifies scales | 100 | 100 | 80 | 83 | 100 | 100 | 100 | 100 |
| 6. Identifies balance scale | 55 | 92 | 10 | 92 | 10 | 50 | 33 | 78 |
| 7. Identifies balanced | 73 | 100 | 80 | 92 | 70 | 86 | 67 | 78 |
| 8. Identifies balance | 73 | 92 | 60 | 75 | 60 | 38 | 78 | 44 |

C. Interpretations

1-3. Specific instruction was not provided in the Primary Unit on the prerequisite concepts (heavy, heavier, heaviest). The observed scores, however, indicate that some instruction may be necessary at the primary level. It should also be noted that these concepts are difficult to validly test at the identification level and the scores, therefore, may be unnaturally low.

4. Generally, the pretest scores show that minimal instruction seems necessary at the "identification of scales" level. Gains are satisfactory but it is not unrealistic to expect 100% performance on this objective. Therefore, additional activities seem necessary to relate the phrase "used to find out how heavy things are" to the term "scale."

5. Based on data obtained on "identifying scale," the instruction can assume that children at the primary level have this objective mastered, and only minimal instruction would be needed to introduce the term.

6. Pretest scores would indicate that instruction on the concept of the balance scale would need to be introduced at this beginning identification level. Gains in three of the four schools indicate that the instruction provided in this lesson is adequate. Further analysis should be made on the tests from School 3 to determine what complications exist there (e.g., children selecting the scale, a distractor, when asked to find the balance scale).
7. Although the children did not seem to be able to identify a balance scale (objective 6), pretest scores indicate that only a review of the concept balanced may be needed. However, with such high pretest scores 100% performance after the unit, if not after the lesson (which was not tested) should have occurred. Therefore, some revisions may be needed.
8. The data obtained from testing this objective are not interpretable. No instruction related to the objective was provided in the unit. Judgments were made by having the children lift objects ( a more valid and appropriate technique for deriving "weight"), but children were never required to make picture recognition.

Lesson 1 - Balance and Scale

A. Objectives and Materials

1. All felt objective was clearly stated and appropriate for "all" children in class.
2. All felt that "none" of the children had reached the objective before lesson began.
3. All felt that materials will need to be provided, especially the balance.

B. Pre-Activity (Structured)

1. All felt activity was appropriately structured
2. Need for a pre-activity varied : none-1, some-1
   a. Helpful for those needing it
   b. Good for those knowing concepts
3. Time: 5 - 10 minutes

C. Tape Presentation

1. Advance Organizer - when tape only presented the advance organizer, it did not prepare the children for the lesson.
2. Definitions - obtained functional definitions for both "balance" and "scale," although may have had this for "scale" before hand.
3. Elaborations -
   a. Father and son on teeter; totter -- superior because have had experience with them
   b. Nurse's scale better than bathroom scale
4. Time: 15-20 minutes for best classes
5. Additional Comments
   a. Difficulty drawing objects on balance to make it balance until after comparing objects by sight, lifting and balancing (and reviewing tape). Worksheet #5
   b. Asked children what would happen if another boy(s) got on the teeter-totter with the man. Picture #1

D. Post-Activities

1. All felt that the post-activities did not strengthen the concepts taught in the tape.
2. Sequencing - "balance" and "scale" should perhaps be together (e.g., compare objects on balance for heavier and lighter, then get exact weights on scale).
3. Required Activities
   a. (#1) Attempt to make a balance was unsuccessful. Very difficult to find things that balance (should suggest exact things that balance).

b. (#2) Activity considered as "okay." Pupils couldn't think of things that balanced. Worked after checked a number of things on a balance.
c. (#3) Good activity - enjoyed. Would be beneficial to combine with #1 - and work into exact weight.

4. Optional Activities
(#1) In making mobiles, length of string became important factor, not that the hanging things must balance in weight.

E. General Comments on Lesson

1. Lesson should be first.
2. Objective of lesson was met (however, children didn't seem to end up with the distinction that the balance tells if something is heavier or lighter, and scales weigh things.
3. Felt "most" to "all" children knew concepts at end of lesson.
4. Children enjoyed lessons, especially weighing or checking guesses as to "heavier" or "lighter" on balance.
5. Time: (Length felt to be "about right")
   a. 1 day - 45 minutes
   b. 5 days - 125 minutes - longer than necessary maybe, but felt balanced objects were as important as heavy and light ones. (more than one activity per day)
6. Extensions - make mobiles where balancing is important; use subtraction to see how heavier or lighter one is than the other; learn to read the scale.

LESSON 2: HOW HEAVY IS IT?

LESSON 3: OUNCES

LESSON 4: TON

A. Objectives

1. Identifies "all the things that you think would be weighed in pounds" from a set of various pictured objects.
2. Identifies "all the things that you think would be weighed in just ounces" from a set of pictured objects.
3. Identifies an object weighing 8 ounces from a set of four platform scales reading various weights.
4. Identifies an object weighing 1 pound 8 ounces from a set of four platform scales reading various weights.
5. Identifies "all those things that you think should be weighed in tons" from a set of pictures.

B. Performance of classes

| | School 1 | | School 2 | | School 3 | | School 4 | |
|---|---|---|---|---|---|---|---|---|
| | Pre | Post | Pre | Post | Pre | Post | Pre | Post |
| 1. Identifies pounds | 27 | 33 | 0 | 25 | 20 | 50 | 33 | 33 |
| 2. Identifies ounces | 18 | 67 | 30 | 58 | 20 | 75 | 11 | 44 |
| 3. Identifies 8 ounces (on a scale) | 0 | 8 | 0 | 25 | 0 | 0 | 11 | 0 |
| 4. Identifies 1 lb. 8 oz. (on a scale) | 0 | 25 | 0 | 25 | 0 | 25 | 22 | 11 |
| 5. Identifies tons | 45 | 50 | 30 | 33 | 0 | 13 | 0 | 44 |

C. Interpretations

1. Considering the composition of the test question (make judgments from pictures on objects that would be weighed in pounds), the low pretest scores are not surprising. Also, since the children were not taught to make such types of picture judgment, the lack of increase in scores is not surprising. In view of these results, a more valid way to test the instruction of pound is definitely indicated.
2. The same type of considerations as noted in objective 1 (pounds) can also be made for objective 2 (ounces). The higher posttest scores indicate, however, that (1) instruction was satisfactory, (2) data on this objective may be valid (e.g., the definition of ounces is more generalizable than that for pounds: "Weigh light things in ounces." Therefore, selection of the pictures of very light things would be correct).

3.& 4. Administration of these test items was difficult and the pictures were small and it was difficult to read the dials.

Verification that these test items did not measure what they were designed to came from teacher's comments and behavioral checklists that indicated students were able to read scales.

5. Comments made for objectives 1 and 2, also hold here (tons). Gains were significant and an improved method to test the effectiveness of the instruction on tons is indicated.

Lesson 2 - How Heavy Is It?

A. Objective and Materials

1. All felt objective was clearly stated and appropriate for "some" children in class.
2. It was felt that "some" or "most" of the children had reached the objective before lesson began.
3. Many of the materials need to be provided, or should be changed in case there is no refrigeration (butter, hot dogs).

B. Pre-Activity - agree that none was needed.

C. Tape Presentation

1. Advance Organizer - all felt children understood and listened to this advance organizer (familiar, gave responses).
2. Definitions - functional definitions of weigh, weight (pounds). [Word "pound" was associated with #1]
3. Elaborations - generally helpful; problems in pronunciation of "pound" and picture on p. 5 where children thought airplane was real and therefore "heaviest."
   a. Elaboration on nurse and weighing (p. 16) would have been more effective on p. T19.
   b. P. T17 was confusing; children thought butter was added to hot dogs on scale, therefore equaling 2 pounds.
4. Time: (varied) - 40 minutes (with explanation of problems - real vs. toy airplane). 30 minutes minimum
5. Additional Comments
   a. Some problems with pictures and explanation.
      (1) Airplane looked real (p. 2)
      (2) Could not believe dog weighed 75 lbs. (p. 4)
   b. Good relationship between lesson words (Weigh to find how heavy; need scale to tell exactly how much something weighs; number that comes up is weight; we read the weight in pounds).

D. Post-Activities

1. All felt activities did strengthen the concepts presented.
2. Required Activities
   a. (#1) Very good activity.
      (1) Problems - one-pound weights hard to find; teacher shouldn't have to go out and buy them.
      (2) Expansions - after felt 1 lb. weight, took it away and compared another object with it (heavier or lighter?). Used balance then scale to compare objects.

b. (#2) Good activity to have children guess if object is lighter or heavier than a pound. Had trouble weighing on scale because didn't know how to use scale. Maybe need lesson on how to read a scale.

c. (#3) Good <u>if</u> children had no problem reading the scale.

3. <u>Optional Activities</u>

a. (#1) - would do if chart itself were provided; children have trouble making charts.

b. (#2) - have weight chart - check every month; do some subtracting.

4. Other activities suggested - visit store and look for things weighing 1 lb., 2 lbs., 5 lbs., and 10 lbs. (put these into chart under Optional #1).

E. General Comments on Lesson

1. All felt objective of lesson was met.
2. All felt "<u>all</u>" children knew vocabulary concepts at end of lesson.
3. Most important part of lesson was where it related to children's own weight (knew from experience).
4. Children enjoyed lesson - especially actual weighing (even for those who couldn't read the scale).
5. Time:
   1 day - 35 minutes (1 lesson/day)
   4 days -160 minutes (more than one activity per day)
6. Long-term projects - continue chart of weights, comparing weight from one month to next as well as comparing students.

Lesson 3 - Ounces

A. Objective and Materials

1. It was felt that objective was appropriate for "most" or "all" of the children.
2. It was felt that either "none" or "some" of the children had reached objective before lesson.
3. Materials very difficult to find - most suggest specific objects; also, scale must be relatively accurate - may be difficult to obtain.

B. Pre-Activity (Structured)

1. Suggestion - when introducing ounce, first balance actual 1lb. weight with other object (lighter) before putting on scale ("prove" guess).
2. All felt "all" children needed pre-activity.
3. All felt "all" children benefitted from activity (although all might not have been fully prepared for tape).
4. Time: 30 minutes - (1 day, to get all kids to scale to read it)

C. Tape Presentation

1. Advance Organizer - all felt advance organizer was good, but there was uncertainty as to whether it prepared the children for the lesson.
2. Definition - functional definition of ounces was obtained.
3. Elaborations - generally helpful; especially baby (p. 3) and cookies (p. 4). Even though they liked the sequence from instruction on pounds to instruction on ounces to instruction on pounds and ounces, they felt this flow might be difficult for a number of students. Had little difficulty with "ounces" but combining them required more experiences.
4. Pictures were generally good
   a. (#1) - good carry over from other lesson.
   b. (#2) - might have had some things about 1 lb. in weight with pupils choosing things less than one pound (could prove with scale).
   c. (#4) - elaborations requiring buying of such goods will not generally be accepted.
5. Time: 35 minutes (varied) - depends a lot upon time for combining pounds and ounces.

D. Post-Activities

1. All felt post-activities strengthened concepts taught in tape.

2. There was some feeling that more activities should have been suggested.
3. Ordering - all would put number 2 first; order of 1 and 3 varied after that (one felt #3 was not worthwhile; one felt #1 was very hard).
4. Required Activities
   a. (#1) - very hard but good; could be a lesson in itself; students don't really see ounces as part of a pound, but rather as something separate.
   b. (#2) - excellent; should be first.
   c. (#3) - did not like; didn't see importance; required teacher to buy too much.
5. Optional Activities
   a. (#1) - should be required; however, difficult to obtain this kind of scale.
   b. (#2) - very good
   c. (#3) - revised so children were weighing things again.
   d. (#4) - didn't do
   e. (#5) - did before - covered abbreviations.
   f. (#6) - too advanced

E. General Comments on Lesson

1. Ordering of lesson good.
2. Suggestion - divide lesson into two lessons, one on "ounces" and one on reading scale in pounds and ounces.
3. All agree that more work is needed on pounds and ounces.
4. Generally, felt vocabulary concepts had been obtained by "all" children ("ounces," not necessarily "pounds and ounces").
5. Children enjoyed lessons (novelty of weighing objects may be wearing off).
6. Time:
   a. 2 days - 90 minutes (should be divided into 2 lessons)
   b. 5 days - 160 minutes (one activity/day and reviews)

Lesson 4 - Tons

A. Objectives and Materials

1. All felt that objective was clearly stated and appropriate for "most" or "all" of children in class.
2. It was felt that either "none" or "some" of the children had reached the objective before lesson began.

B. Tape Presentation

1. All agreed that no pre-activity was needed.
2. Advance Organizer - children seemed to listen to and benefit from the advance organizer.
3. Definition - obtained functional definition for "tons." Problem: Things that were very heavy to children weren't really heavy enough to weigh a ton (bookcase, piano). Solution: Asked for things they couldn't move (like car).
4. Elaborations - generally helpful; elaboration with p. 2 was more helpful when related to classes in school rather than to the group of children in the picture.
5. All pictures good, especially the worksheet.
6. Time: 5 - 20 minutes

C. Post-Activities (only one was used)

1. Not sure that post-activities strengthened the concepts taught in tape. (Felt there wasn't much to be done with "tons.")
2. Optional Activities (all were optional)
   a. (#1) - very good; related to other lessons
      Variation: played game, children had to tell of things that weighed ounces, pounds, or tons.
   b. (#2) - not used
   c. (#3) - not used; felt to be too advanced

D. General Comments on Lesson

1. Objective of lesson was met.
2. All felt "all" children knew vocabulary concepts at end of lesson.
3. Children enjoyed lesson (for some, worksheet was most popular aspect, for others, it was the least popular).
4. Time: (Length felt to be about right)
   a. 1 day - 20 minutes (one activity per day)
   b. 1 day - 35 minutes (one activity per day)

Comments on Unit as a Whole

A. Ordering of lessons on Primary Weight Unit

1. Ordering was generally good, but some changes were suggested for dividing a present lesson into more than one lesson and for adding a lesson.
2. It was felt that something will have to be done on "reading a scale" to insure that the children understand the purpose of a scale.
   a. Different scales are read differently - some increase by 1 pound, others by 5 pounds, and others by 10 pounds (bathroom scale); children need to be able to transfer between scales.
   b. Would suggest that the children first have worksheets on reading scales, and then have real scales.
3. It was suggested that the concept of "pounds and ounces" was very difficult, and possibly should be optional, and for the better kids.
4. SUGGESTED REORDERING:
   a. Balance, scale
   b. Weigh (weight), pounds
   c. Reading a scale
   d. Ounces
   e. Opt. Lesson: Pounds and Ounces
   f. Tons

B. Advance Organizers
1. The children didn't seem to pay attention to the advance organizer unless they were required to point to something or to answer a question.
2. Generally, if the children looked at the picture, they listened better.
3. It might help if the tape had more of an introduction before the advance organizer was started.

C. The tape presentation may need to say each vocabulary word more and have the children repeat it more often -- the children often had trouble remembering the target word even though they knew the concept.

A. Lesson 1 - Balance and Scale

1. Pre-Activity
   a. The pre-activity is long; should probably be done on the day before the tape presentation.
   b. The pre-activity should then be briefly reviewed immediately before the tape.
2. Tape Presentation
   a. "Balancing" - children had no problems with this concept.
      (1) Generally, the teachers liked the teeter-totter example as it is.
      (2) Might want to end by posing question: "What would happen if another boy was added?"
      (3) Might want to start out with a balanced teeter-totter, and then go into example given in book.
   b. Summary Activity should be saved for a post activity.
   c. The balance scales available were really only good for weighing lighter things.
3. Post-Activities
   a. Worksheet #5 - eliminate drawing aspect (kids responded according to size of pictures drawn); maybe this should just be used for review.
   b. Many of the post-activities could be combined and made step-wise. Just have children compare things by lifting, then have them balance the things, and then weigh them.
   c. A number of deletions and changes were suggested:
      (1) Drop #2 (worksheet)
      (2) Make Required #1 (making balances) an optional activity.
      (3) Drop Optional #1 (making mobiles)

B. Lesson 2 - How Heavy Is It?

1. Introduction: Materials (1 lb. weights) were a little hard to obtain. Other alternatives should be suggested (pancake mix; can with gravel or something to make 1 lb. weight).
2. Tape Presentation
   a. Picture Problems (and related suggestions)
      (1) #1 - Should introduce this picture by saying "Everything weighs something" (children thought bug had no weight at all).
      (2) #2 - Question on nurse is not really appropriate here.
      (3) #3 - Teachers did not weigh pound things at end of definition; most felt this weighing should be saved for the post-activities (if any weighing is done here, it should be done only by the teacher).
      Problem: Kids might add weights here (put butter on top of hot dogs on scale = 2 lbs.).
      (4) #4 - Dog is a problem.

b. It was felt that this tape presentation was too long; would try to divide into two parts.
c. High numbers (for weights) should be avoided since kids have trouble with these.

3. Post-Activities
   a. Would like to see a directed activity on reading the scale; mainly on 1-20 lbs.
   b. Clarify materials - need only one 1 lb. weight for these activities.
   c. For Optional Activity #1, a chart should be provided (or suggest using the blackboard).

C. Lesson 3 - Ounces

1. Introduction
   a. This lesson should be split into two lessons.
      (1) Ounces
      (2) Ounces and pounds
   b. There are problems obtaining these materials. More possibilities should be suggested (use sand in containers, or bags with "things" put in them to make a certain weight).
2. Tape Presentation
   a. The first part (in just ounces) is very good.
   b. The tape does not really stress the idea of a standard.
3. Post-Activities
   a. Might want to have kids find their own birthweights.
   b. Optional Activity #6 is too advanced; we may just want the kids to count on the scales.

D. Lesson 4 - Tons

1. Introduction
   Problem: We omitted things weighing "heavy" in pounds. Thus, when we got to tons, things weighing "tons" were confused with very heavy things that would be weighed only in pounds.
2. Tape Presentation
   a. Cover - it was distracting for some to have the boy actually lifting something that weighed "tons." Should have boy trying to lift hippo.
   b. Pictures
      (1) #1 - relate to kids by saying, "These hot dogs would fill the room."
      (2) #2 - Make concrete; relate to kids in class.
   c. Perhaps the cover picture should also be placed at the end to summarize the lesson - what's wrong with picture (kids couldn't lift hippo if he weighs "tons").
3. Post-Activities
   Worksheet is very good summarizer of Pourds, Ounces, and Tons.

## Discussion

The data presented in the Results section of this paper were used to revise the Measurement of Weight Unit into a version which would undergo large-scale field-testing. Each of the feedback sources reported here (i.e., testing, teacher evaluation forms, and Teacher Review Board meetings) provided important information during the formative evaluation of the Weight Unit. For example, the test data identified specific areas where instruction was weak. The evaluation forms tapped the teachers' immediate reactions to each aspect of the lessons in the Unit, and the Teacher Review Board meetings allowed the teachers to discuss their reactions with project directors and with other teachers, in order to make final recommendations for revision.

Six aspects of the pilot-test version of the Weight Unit were evaluated, as specified in the formative evaluation design (cf., Krus, Taylor, Thurlow, Turnure, & Howe, 1974): 1) Need for instruction, 2) Instructional effectiveness, 3) Design of the materials, 4) Content, 5) Sequencing, and 6) Test instruments. Each feedback source provided specific information about one or more of these aspects, and generally, every aspect was evaluated on the basis of feedback from several sources. In all cases, the information from all sources was reviewed by project directors and by the individuals responsible for revising the Unit. This composite evaluation of the pilot-test version was then used to revise the Unit.

The need for a program of instruction to teach weight-related concepts and skills to EMR children was supported by the pretest data obtained during the formative evaluation. Both pre-primary and

primary level children showed such needs. For example, only 54% of the pre-primary children correctly identified instances of "lighter" and only 30% identified instances of "as heavy as ." While the primary children did not show this same need for instruction related to the weight comparatives (e.g., 66% identified instances of "heavier"), their identification of pounds (20%) and their reading of pounds and ounces on a scale (6%) certainly suggest that several weight-related skills had not been mastered.

Although teachers indicated that there were some weight-related skills not appropriate for their children (e.g., reading a postage scale, etc.), certain weight-related skills and concepts were viewed as highly desirable for EMR children to master (e.g., basic comparatives, using a bathroom scale, etc.). Based on this information and pretest data obtained, the need for pertinent instruction dealing with weight and its measurement was clearly demonstrated by the formative evaluation.

The instructional effectiveness of the Weight Unit was of primary concern in the formative evaluation, and served as the major basis for revision of the instruction. Although behavioral objectives were not specifically stated in the Weight Unit instruction, a test item related to the identification of each of the vocabulary words and/or the definitions was constructed and included in both the pretest and posttest. The results from these tests pointed to specific areas where the instruction had not been effective. For example, in this pilot-test, the data indicated that the equivalence concept (as heavy as) was very difficult for the children even after the instruction had been completed. The mean posttest mastery level of 24% on the "as heavy as" identification test item clearly indicated that additional instruction was needed.

All specific problems in the instruction (e.g., decrease in performance on the "heavier" test item, minimal increase on items related to reading scales), were subjected to careful scrutiny to determine whether the problems arose from testing procedures, instructional content, the sequence of instruction, or from the design of the materials themselves. Each source of feedback was consulted to make final decisions as to the revisions which would be made.

Several major revisions in the design of materials were made as a result of the formative evaluation feedback from the Weight Unit. Most of the changes were ones made to improve the effectiveness of the materials for the children. A major problem identified by the formative evaluation concerned the "advance organizers" which introduced each tape presentation. Their purpose was not only to introduce the content of the tape presentation but also to obtain the children's attention and interest for the remainder of the presentation. Data from teacher evaluation forms and the discussions at the Teacher Review Board meetings indicated that these purposes were not being met. Based on this feedback, revisions in pictures, the use of male vs. female voices, and the use of teacher-presented organizers were all tested in the formative evaluations of later units (cf., Thurlow, Krus, Howe, Taylor, & Turnure, 1974a,b) to determine the most effective way to obtain the children's interest and introduce the tape presentation. These evaluations indicated that the use of an introductory tape lesson (to accustom the children to listen to a tape presentation and simultaneously to look at pictures, before actual instruction was started) and a central character (to introduce the introductory tape and all other lessons) would increase

overall interest as well as maximize the effectiveness of the advance organizer. This was supported by the formative evaluation of the Time with the Clock Unit (Krus, Howe, Thurlow, Taylor, & Turnure, 1974) where the use of a central character was first tested before implementation into the field-test version of the Measurement of Weight Unit. In the revised Weight Unit instruction, a small boy named Benji became the central character.

Other design revisions suggested by the formative evaluation of the Weight Unit related to the use of "stop tapes," the format of the tape presentation, the use of sequential books, and the use of Big Picture Books. At the Teacher Review Board meetings, the teachers suggested that more "stop tapes" should be employed (as many as one for every picture presented) to allow the teachers to review the definitions presented. This suggestion was modified (as a result of the formation evaluation of the Length Unit; Thurlow, Krus, Howe, Taylor, & Turnure, 1974b) and incorporated in the field-test version of the Weight Unit. In addition, the format of the tape presentations on the weight comparatives was found to be too similar in each lesson. These lessons were revised, and such variations as the use of stories and concrete manipulations were employed to introduce variety into these tape presentations.

A major design change noticable in the field-test version of the Measurement of Weight Unit was indicated through the formative evaluation. There were suggestions that the distinction between "pre-primary" and "primary" children was not the best basis for organizing the instruction. The formative evaluation of the Money and Length Units (Thurlow, Krus, Howe, Taylor, & Turnure, 1974a,b) supported this indication, and a

system of sequential books was tested in the formative evaluation of the Time with the Clock Unit (Krus, Thurlow, Howe, Taylor, & Turnure, 1974). This revised organization was found to be effective and was therefore employed in the revised field-test version of the Measurement of Weight Units as well as all other units in the Money, Measurement and Time Program.

Another change in the design of materials made to increase their effectiveness for EMR children was suggested by the formative evaluation of the Weight Unit as well as those of the Money and Length Units (Thurlow, Krus, Howe, Taylor, & Turnure, 1974a,b). In the pilot-test version, pictures were in the form of individual student texts. Each child had his own book and was responsible for turning pages, etc. Teachers noted that younger children had great difficulty manipulating the books and attending to the instruction at the same time. Therefore, the revised version of the Unit included a Big Picture Book for the lower-level instruction (Book One) that was regulated by the teacher rather than the children.

Other changes made in the design attempted to increase their use-ability for the teacher. For example, a section listing the "materials needed" for instruction was included at the beginning of each lesson and again before the component (pre-activities, tape presentations, and post-activities) for which the materials were needed. A specially designed balance scale was also included with the revised materials because of the general unavailability of balance scales to elementary-level teachers, and the inappropriateness of most balance scales for EMR children. More concern for the accessibility of other materials was also observed in revising the Unit.

Another change in the design of the materials reflected the need for a more appropriate way to specify behaviors that the children were to master following the instruction. Specific behavioral objectives were constructed for each lesson and noted for the teacher. This revision allowed the teacher to more thoroughly understand the purpose of each lesson, and to more systematically determine the pacing of instruction on the basis of children's performances.

In terms of content of the Weight Unit, several revisions were made as a result of the formative evaluation. For example, greatly expanded instruction on the equivalence term (as heavy as) was included in a specific lesson (see Appendix 5). In fact, the major content alteration of the Weight Unit (both pre-primary and primary) involved the inclusion of greater instruction on all concepts presented, and the inclusion of instruction on more practical weight-related skills (e.g., weighing oneself on bathroom scale, reading scales, finding weights on grocery items, etc.).

Another major content revision involved the structured presentation of weight comparatives. This revised presentation first made use of concrete manipulations, then manipulations with pictures and finally the use of pictures alone. (In the pilot-test version the children were asked to make weight comparisons solely on the basis of picture representations.) The need for such a revision was indicated by all sources of feedback during the formative evaluation.

Of course, many smaller changes were made in the content of the Weight Unit as a result of the formative evaluation. Most of these

changes can be identified by comparing the pilot-test version with the revised version. Investigation of Appendix 5, which describes the revised version of the Measurement of Weight Unit (in comparison with Appendix 1) will also reveal many of the content changes which resulted from the formative evaluation of the Weight Unit.

Sequencing of instruction underwent extensive changes as a result of the formative evaluation. Major changes were made with respect to the comparatives. Teacher feedback from the present evaluation suggested that the comparative terms should be presented immediately following instruction on the basic term "heavy" and "light"; then, the equivalence concept (as heavy as), and finally the superlatives (heaviest, lightest) should be presented. Formative testing of the comparatives in the Length Unit (Thurlow, Krus, Howe, Taylor, & Turnure, 1974b) indicated however, that the ordering should be: 1) base terms (heavy, light), 2) "heavy"-related terms (heavier, heaviest), 3) "light"-related terms (lighter, lightest), and finally, 4) equivalence term (as heavy as). This latter format was used to sequence the first book instruction in the revised Weight Unit.

As noted above, the sequencing within instruction on the comparatives also changed so that instruction began at the manipulative level, and then proceeded to identification and expressive use. Behavioral objectives relating to these three levels were included for each comparative term.

The second book of the revised Unit perhaps reflects the major format changes incorporated as a result of this formative evaluation. Instruction on reading scales was introduced extensively, and the skill of measuring weight in "pounds and ounces" was separated from the lesson on

"ounces" and made optional. Appendix 5 (in comparison with Appendix 1) provides an excellent picture of the lesson sequence changes made in the Weight Unit.

A final outcome of the formative evaluation of the Weight Unit related to testing procedures. Since the Weight Unit was the first unit in the Money, Measurement and Time Program to undergo formative evaluation, testing procedures were relatively unsophisticated. The changes suggested by the formative evaluation of the Weight Unit were major and became the basis for testing in the formative evaluations of all other units in the Money, Measurement and Time Program.

One major revision made in testing procedures involved the type of test used for evaluation. The data obtained from the use of only group-administered tests was found to provide inadequate measures of the Unit during the formative evaluation. Basically, this type of test allowed only for the testing at the "identification" behavior level (e.g., the use of pictured scales to measure the children's ability to "read" scales was pointed out as inappropriate and invalid by the participating teachers). As a result, data indicating the children's ability to apply concepts in concrete situations or to use th terms verbally were totally missing. The use of the behavioral checklists to obtain this type of information was found to be inadequate. For various reasons, the behavioral checklists were not used by the teachers and/or were not returned to project personnel.

The data obtained from the group-administered test during this formative evaluation were generally found to be inferior in providing the type of information needed to revise an instructional product. Through the formative evaluation of the Weight Unit, however, four testing procedure

needs were identified and incorporated in the evaluation of the other instructional units in the Money, Measurement and Time Program. First, specific behavioral objectives needed to be identified and tested. Second, more than one test item was needed on some of the objectives to effectively determine the performance level of the population being tested. For example, the children should be able to both identify and label a heavy object, and thus both levels should be tested. Third, it was determined that the use of only a pretest and a posttest did not provide sufficient information on the children's attainment of the desired behaviors. Ideally, it was found that tests should be administered at various points during instruction to more efficiently determine when objectives are mastered (e.g., immediately after instruction or at some later lesson), or at what point mastery drops off. Finally, the use of individually administered tests was seen as imperative for obtaining the necessary feedback on mastery at several different behavioral levels (e.g., utilization, demonstration).

The revised test for the Weight Unit is presented in Appendix 6. It is a 27-item individually administered test which reflects the expanded content and objectives of the revised Unit.

In addition to the noted revisions of the tests, attempts were made to include feedback data from outside sources (i.e., consultants) and systematic data from classroom observations in the remaining formative evaluations conducted. Problems were encountered during the Weight Unit evaluation in the scheduling of testing and especially of the classroom observations. As a result, the use of "weekly lesson plans" by the participating teachers was included in the next unit that was pilot-tested.

The use of behavioral checklists as a source of feedback was attempted again in the Length Unit formative evaluation and then dropped due to nonresponse.

Revisions in the design, content, and sequencing of the Weight Unit, and the accompanying tests, grew directly out of the formative evaluation plan of the Weight Unit. The value of this step in the overall evaluation plan of the Vocabulary Development Project (cf., Krus, Taylor, Thurlow, Turnure, & Howe, 1974) was confirmed by the relatively final form of the Measurement of Weight Unit which resulted (Krus, Thurlow, Taylor, & Turnure, 1974). The formative evaluation process employed here, with the revisions noted, is one which has been used by the Vocabulary Development Project to evaluate other instructional units and one which would be valuable to many other development and evaluation projects.

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## Footnotes

[1]The formative evaluation of the Measurement of Weight Unit benefitted from the input of many individuals. A large debt of gratitude is due, of course, to Jeanne Morrissey, Cristol Peterson, and Delores Anderson, the three teachers who assisted in the development of the Measurement of Weight Unit. Appreciation is also extended to the Special Education Department of the St. Paul Public Schools for its cooperation, and especially to the teachers and children who pilot-tested the materials. Finally, special thanks are due to Joni Blumenfeld Troup, JoEllen Milstein, and Vicki Ryan for their technical assistance during all phases of the evaluation.

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APPENDICES

1. A Description of the Pilot-Test Version of the Weight Unit
2. Weight Unit Pilot-Test Questions
3. Behavioral Checklists
4. Sample Evaluation Form
5. A Description of the Revised Version of the Measurement of Weight Unit
6. Revised Weight Unit Test

# Appendix 1

## A DESCRIPTION OF THE PILOT-TEST VERSION OF THE WEIGHT UNIT

### Pre-Primary Weight Unit

The Pre-Primary Weight Unit presents the comparatives of weight and two basic tools for measuring weight. There are four lessons in this unit.

Lessons 1-3 in the Pre-Primary Weight Unit present the comparatives of weight. These comparatives provide the children with a foundation upon which other concepts more directly related to measurement skills can be built.

Lesson 1: "Heavy and Light"

Vocabulary Words: HEAVY, LIGHT

The children are taught the basic comparatives related to weight.

Lesson 2: "Heaviest and Lightest"

Vocabulary Words: HEAVIEST, LIGHTEST

The children are taught to compare the weight of many objects to find the heaviest and/or lightest ones.

Lesson 3: "Heavier and Lighter"

Vocabulary Words: HEAVIER, LIGHTER

The children are taught to compare the weight of two objects to find out if they weigh the same, or if one is heavier or lighter than the other.

The Unit concludes with an introduction to the balance and the scale as two tools for measuring comparative weights.

Lesson 4: "Balance and Scale"

Vocabulary Words: BALANCE, SCALE

The children are taught the use of a balance to compare weights of objects and the use of a scale to find out exact weight measurements.

Primary Weight Unit

The Primary Weight Unit presents the basic tools for measuring weight and the standard units of weight. There are 4 lessons in this unit.

Lesson 1 in the Primary Weight Unit introduces two tools for measuring weight. It is assumed at this point that the children have mastered the comparatives of weight (if this is not so, several optional review activities are suggested at the beginning of the unit, or the teacher may look at the relevant pre-primary lessons).

Lesson 1: "Balance and Scale"

Vocabulary Words: BALANCE, SCALE

The children are introduced to two tools for measuring weight. Following the development of the concept of balancing, the children are taught that a balance is used to compare two objects to see which one is heavier or lighter, or if they weigh the same. The scale is then introduced as a tool to find the exact weight of an object.

The remaining lessons of the Primary Weight Unit develop the concepts of weight and weighing; also three standard units of weight - pounds, ounces, and tons - are presented.

Lesson 2: "How Heavy Is It?"

Vocabulary Words: WEIGH (WEIGHT), POUNDS

The children are taught the label "weigh" for the process of "finding out how heavy something is" and that we weigh most things in pounds (i.e., pound is a unit of weight). The word "weight" is introduced.

Lesson 3: "Ounces"

Vocabulary Word: OUNCES

The children are taught that an ounce is a unit of weight and that light things are weighed in ounces. In addition, the children are introduced to a more accurate way to measure objects - weighing objects in pounds and ounces.

Lesson 4: "Tons"

Vocabulary Word: TONS

The children are taught that a ton is another standard unit of weight and that very heavy things are usually weighed in tons.

Appendix 2

## WEIGHT UNIT PILOT-TEST QUESTIONS

Pre-Primary Weight Evaluation

3. Look at all the pictures on this page. Find the things that you think are heavy and mark them with an X. Remember to look at all the pictures on the page and make an X on everything that is heavy.

4. Everybody look at the top of this page. See the telephone. I want you to think how heavy the telephone is. Now find the things in the bottom of the picture that are heavier than the telephone and mark each one with an X — make an X on everything that is heavier than the telephone.

5. Everybody look at all the things on this page, and find the thing that you think is the heaviest. Remember to look at everything on the page. Make an X on the heaviest thing.

6. Look at all the things on this page. You've all seen this picture before but this time I want you to find everything that is light. Mark an X on everything that you think is light.

7. Everybody look at the doll at the top of this page. Think how heavy the doll is. Mark the things in the bottom of the picture that you think are lighter than the doll. Remember to make a big X on everything that is lighter than the doll.

8. Look at all the things on this page. You've all seen this picture before but this time I want you to mark the thing that you think is the lightest. Remember to make an X on the thing that is the lightest.

9. Look at the picture of the orange at the top of this page. Now pick the thing in the bottom of the picture that you think is as heavy as the orange. Make an X on the one thing that you think is as heavy as the orange.

10. Find the balance and make an X on it. Remember to look at all 4 pictures and mark an X on the balance.

11. Find the scale that is balanced and mark it with an X. Remember to look at all the pictures and mark the scale that is balanced. This page has four pictures of a balance on it, but only one of these balances is balanced. Remember to look at all the pictures and mark the one that is balanced with an X.

12. Look at the picture at the top of your page. You see a comb on a balance scale. I want you to pick one thing from the bottom of your picture that you think would balance the comb. Make an X on the thing that would balance the comb.

13. Look at the picture of the balance scale. Mark an X on the side of the scale that is heavier.

14. Look at the top picture. The boy wants to find out how heavy his ball is. Find the thing in the bottom of the picture that he should use to find out how heavy his ball is. Remember to make an X on the thing he should use to find out how heavy his ball is.

15. Mark everything on this page that is a scale. Remember to look at all the pictures and make an X on everything that is a scale.

Primary Weight Evaluation

3. Look at all the pictures on this page. Find the things that you think are heavy and mark them with an X. Make an X over everything that is heavy.

4. Everybody look at the top of this page. See the telephone. I want you to think how heavy the telephone is. Now find the things in the bottom of the picture that are heavier than the telephone and mark each one with an X — make an X on everything that is heavier than the telephone.

5. Everybody look at all the things on this page, and find the thing that you think is the heaviest. Remember to look at everything on this page. Make an X on the heaviest thing.

6. Look at the top picture. The boy wants to find out how heavy his ball is. Find the thing in the bottom of the picture that he should use to find out how heavy his ball is. Remember to make an X on the thing you think he should use to find out how heavy his ball is.

7. Look at all the pictures on this page and find the scales. Mark everything on this page that you think is a scale. Mark an X on all the scales.

8. Look at the 4 scales on this page. Find the scale that has something on it that weighs 8 ounces. Mark an X on the scale that you think has something on it that weighs 8 ounces.

9. Look at all 4 scales on this page. Mark the scale that you think has something on it that weighs 1 pound 8 ounces. Put an X on the scale that has something on it that weighs 1 pound 8 ounces.

10. Look at all the things on this page. Mark an X on all those things that you think should be weighed in tons. Make an X over the things to be weighed in tons.

11. Look at the things on this page. Make an X on all the things that you think would be weighed in pounds. Make an X on everything that can be weighed in pounds.

12. Look at all the things on this page. Make an X on all the things that you think would be weighed in just ounces. Make an X on everything that can be weighed in just ounces.

13. Find the balance and make an X on it. Remember to look at all 4 pictures and mark an X on the balance scale.

14. This page has four pictures of a balance on it, but only one of these balances is balanced. Remember to look at all the pictures and mark the one that is balanced with an X.

15. Look at the picture at the top of your page. You see a comb on a balance scale. I want you to pick one thing from the bottom of your picture that you think would balance the comb. Make an X on the thing that would balance the comb.

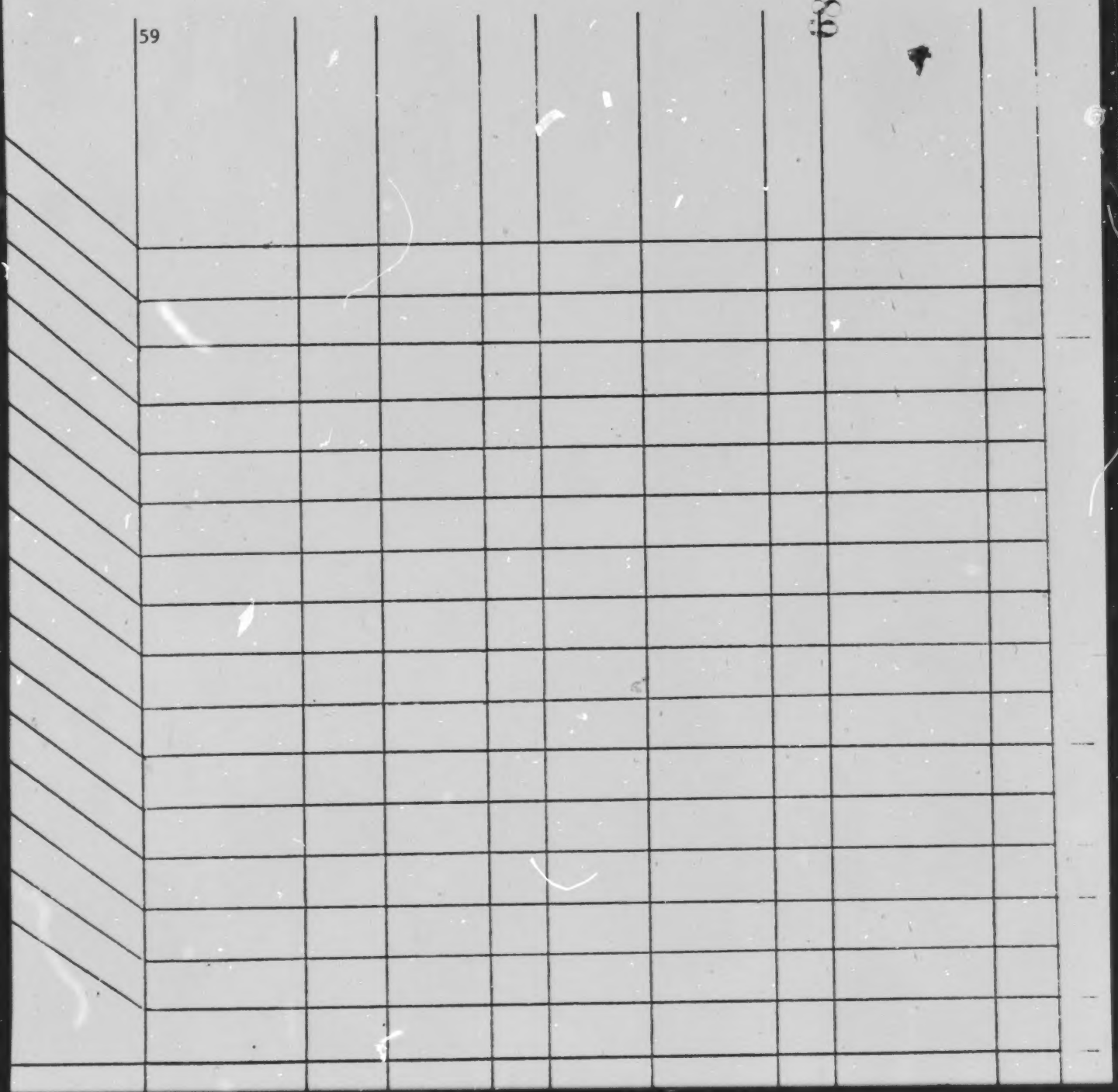
## Behavioral Checklist for Pre-Primary WEIGHT UNIT

| Behaviors | Questions |
|---|---|
| 1. Says things are heavy because they are:<br>a. big (not a complete answer)<br>b. hard to pick up. | Why did you say these were h<br>could be asked individuall<br>with worksheet #2). |
| 2. Lifts 2 objects to find out which is heavier. | Which of these is heavier?<br>What could you do to find ou |
| 3. Names a balance. | What is this? (Point to a b |
| 4. Goes thru correct steps to balance a balance scale. | Would you try to make this b<br>with objects on both sides<br>of balance). |
| 5. Uses a balance to find out which of two items is heavier. | You can use anything you wan<br>find out "which of these i |
| 6. Names a scale. | What is this? (Point to a s |
| 7. Says a scale is used to:<br>a. Find out how heavy something is.<br>b. weigh things. | What do we use a scale for? |

Behavioral Checklist for Pre-Primary WEIGHT UNIT

| Behaviors | Questions |
|---|---|
| ngs are heavy because they<br>(not a complete answer)<br>to pick up. | Why did you say these were heavy? (This could be asked individually in connection with worksheet #2). |
| objects to find out which<br>er. | Which of these is heavier?<br>What could you do to find out which is heavier? |
| balance. | What is this? (Point to a balance). |
| u correct steps to balance<br>e scale. | Would you try to make this balance? (Asked with objects on both sides and scale out of balance). |
| balance to find out which<br>items is heavier. | You can use anything you want to help you find out "which of these is heavier?" |
| scale. | What is this? (Point to a scale). |
| scale is used to:<br>d out how heavy something is.<br>gh things. | What do we use a scale for? |

| Behavioral Checklist for Pre-Primary Weight Unit | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. Says things are heavy because they are: | | | | | | | | | | | | | | | | | |
| a. big (not complete) | | | | | | | | | | | | | | | | | |
| b. hard to pick up. | | | | | | | | | | | | | | | | | |
| 2. Lifts 2 objects to find out which is heavier. | | | | | | | | | | | | | | | | | |
| 3. Names a balance. | | | | | | | | | | | | | | | | | |
| 4. Goes thru correct steps to balance a balance scale. | | | | | | | | | | | | | | | | | |
| 5. Uses a balance to find out which of two items is heavier. | | | | | | | | | | | | | | | | | |
| 6. Names a scale. | | | | | | | | | | | | | | | | | |
| 7. Says a scale is used to: | | | | | | | | | | | | | | | | | |
| a. Find out how heavy something is. | | | | | | | | | | | | | | | | | |
| b. weigh things. | | | | | | | | | | | | | | | | | |



## Behavioral Checklist for Primary WEIGHT UNIT

| | Behaviors | Questions |
|---|---|---|
| 1. | Says to weigh something means:<br>a. to find out how heavy it is.<br>b. to put it on a scale. | What does it mean to weigh s<br>(a. Why do you weigh thin<br>(b. How do you weigh thin |
| 2. | Uses the terms "weigh" appropriately. | How do you find out how heav<br>What do we do when we put th |
| 3. | Names a scale. | What is this? (Point to a s<br>of scale). |
| 4. | Says a scale is used to:<br>a. find out how heavy something is.<br>b. weigh things. | What do we use a scale for? |
| 5. | Uses the word "pounds" appropriately. | How heavy is a boy (footbal |
| 6. | Uses the word "ounces" appropriately. | How heavy is a pin? |
| 7. | Uses the word "tons" appropriately. | How heavy is a big truck? |
| 8. | Uses a scale to weigh things:<br>a. in pounds.<br>b. in pounds and ounces.<br>c. in ounces. | (These can be accomplished a<br>post-activities). |
| 9. | Names a balance. | What is this?(Point to a bal |
| 10. | Goes thru correct steps to balance a balance scale. | Would you try to make this b |

## Behavioral Checklist for Primary WEIGHT UNIT

| Behaviors | Questions |
|---|---|
| o weigh something means:<br>find out how heavy it is.<br>put it on a scale. | What does it mean to weigh something?<br>(a. Why do you weigh things?)<br>(b. How do you weigh things?) |
| he terms "weigh" appropriately. | How do you find out how heavy something is?<br>What do we do when we put things on a scale? |
| a scale. | What is this? (Point to a scale or picture of scale). |
| scale is used to:<br>nd out how heavy something is.<br>igh things. | What do we use a scale for? |
| he word "pounds" appropriately. | How heavy is a boy (football player, etc.)? |
| he word "ounces" appropriately. | How heavy is a pin? |
| he word "tons" appropriately. | How heavy is a big truck? |
| scale to weigh things:<br>pounds.<br>pounds and ounces.<br>ounces. | (These can be accomplished as part of post-activities). |
| a balance. | What is this?(Point to a balance). |
| hru correct steps to balance<br>nce scale. | Would you try to make this balance? |

| Behavioral Checklist for Primary Weight Unit | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. Says to weigh something means: a. to find out how heavy it is. | | | | | | | | | | | | | | | |
| b. to put it on a scale. | | | | | | | | | | | | | | | |
| 2. Uses the terms "weigh" appropriately. | | | | | | | | | | | | | | | |
| 3. Names a scale. | | | | | | | | | | | | | | | |
| 4. Says a scale is used to: a. find out how heavy something is. | | | | | | | | | | | | | | | |
| 5. Uses the word "pounds" appropriately. | | | | | | | | | | | | | | | |
| 6. Uses the word "ounces" appropriately. | | | | | | | | | | | | | | | |
| 7. Uses the word "tons" appropriately. | | | | | | | | | | | | | | | |
| 8. Uses a scale to weigh things: a. in pounds. | | | | | | | | | | | | | | | |
| b. in pounds and ounces. | | | | | | | | | | | | | | | |
| c. in ounces. | | | | | | | | | | | | | | | |
| 9. Names a balance. | | | | | | | | | | | | | | | |
| 10. Goes thru correct steps to balance a balance scale. | | | | | | | | | | | | | | | |

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Appendix 4

SAMPLE EVALUATION FORM



WEIGHT UNIT
Pre-Primary or Primary Level

Lesson # 2 Title How Heavy is it?

Teacher _____

School _____

Date _____

Objective and Materials

Objective

Was the objective stated clearly enough to allow you to understand the goal of the lesson?

For how many children in your class was the objective an appropriate one?

None_____ Some_____ Most_____ All_____

How many children did you feel had reached the objective before the lesson?

None_____ Some_____ Most_____ All_____

Materials Needed

Were you able to obtain the materials that were required?

Did you feel any of the required materials should have been provided?

WEIGHT UNIT
Pre-Primary or Primary Level

Teacher_____

School_____

Lesson #_____ Title_____

Date_____

Tape Presentation

No pre-activity was specified. Did you feel the children needed a pre-activity to prepare them for the tape presentation?

Yes_____ No_____ Unsure_____
Explanation:

What was the effect of the advanced organizer?

Did it interest the children and get them to look at the cover picture?

Yes_____ No_____ Unsure_____
Explanation:

While looking at the cover picture, did the children attend to what was said?

Yes_____ No_____ Unsure_____
Explanation:

Did you feel the cover picture was appropriate for the advanced organizer and the tape presentation as a whole?

Yes_____ No_____ Unsure_____
Explanation:

Did the advanced organizer succeed in preparing the children for what the lesson was designed to teach them?

Yes_____ No_____ Unsure_____
Explanation:

Did the advanced organizer prepare you for the tape presentation?

Yes_____ No_____ Unsure_____
Explanation:

Were the words presented in the best possible order?

Tape Presentation (cont.)

Following the tape presentation, did you feel the children had obtained definitions for each of the words presented in the tape?

| Children Obtained: | For which words? |
|---|---|
| No definition | _____ |
| A rote definition | _____ |
| A definition which wasn't generalizable (e.g., tied to the picture) | _____ |
| A functional definition of the concept | _____ |

Overall, were the elaborations (stories) distracting or helpful to the children?

Helpful_____ Distracting_____ Neither_____

Were there any elaborations which you felt were especially superior or inferior?

Did you feel there was a smooth flow from one word to the next in the tape presentation?

Yes_____ No_____ Unsure_____

In those places during the tape presentation where you were to direct the class, did you feel there was sufficient explanation of what you were to do?

Always_____ Sometimes_____ Not usually_____

Did you feel that when the children completed the tape presentation they understood the relationship between the words presented?

Yes_____ No_____

Tape Presentation (cont.)

How appropriate were the pictures (and/or worksheets) used during the tape presentation?

| Appropriations: | Page number of picture |
|---|---|
| Very good | _____ |
| Appropriate | _____ |
| Distracting | _____ |
| Inappropriate | _____ |
| Unnecessary | _____ |

How long did it take your class to complete the tape presentation?

What do you think is the <u>minimum</u> amount of time in which the tape presentation could be completed?

What do you think is the <u>maximum</u> amount of time it could take to complete the tape?

WEIGHT UNIT
Pre-Primary or Primary Unit

Lesson #_____ Title _____

Teacher_____

School_____

Date_____

Post-Activities
(General Comments)

In general, did you feel that the post-activities strengthened the concepts developed in the tape presentation?

Yes_____ No_____ Unsure_____

How did you feel about the number of suggested activities?

Too many_____ Too Few_____ About Right_____

Were the post activities sequenced in an optimal manner? If not, how would you sequence them?

In general, were the post-activities sufficiently explained so that you could direct them without difficulty?

Yes_____ No_____ Unsure_____

Are there any other activities that you feel should be included in the post-activities?

Post-Activities (cont.)

(Specific Comments)

A number of post-activities were suggested to you. Please list each activity by kind (Required or Optional) and number, and give your opinion of the activity and how you think it might be strengthened (include, if possible, the amount of time spent on each activity). For optional activities, state whether you used the activity or not, and how it worked. It is important that we get your specific comments on each and every activity. Feel free to use as much paper as necessary.

WEIGHT UNIT
Pre-Primary or Primary Level

Lesson #_____ Title _____

Teacher_____

School_____

Date_____

General Comments on Lesson

Please look at the page in your Teacher's Manual which shows the vocabulary words for the unit (page preceding the Table of Contents). Note the position of this lesson within the unit.

Was this chart helpful in letting you understand the place of this lesson in the whole sequence of the unit?

If this lesson is the first one, should it have been first? If this lesson was other than the first lesson, did it follow from previous lessons?

Was there a specific lesson needed before this lesson should have been presented? If so, what type of lesson was needed?

Do you feel that the children in your class are now educationally and motivationally ready for the next lesson?

Look at the objective for the lesson. Did the activities and tape presentation of the lesson meet this objective?

How many children did you feel knew the vocabulary concepts at the end of the complete lesson (tape and activities)?

None_____ Some_____ Most_____ All_____

General Comments on Lesson (cont.)

Is there any one point within the lesson which you felt was most critical to the mastery of the concepts? Where?

Did the children enjoy the lesson?

What aspect of this lesson was the most popular?

What aspect of this lesson was the least popular?

Are there any changes you would recommend to enhance the children's enjoyment without detracting from the lesson?

How much actual time did you spend on this lesson?

Total number of days?_____

Approximate total amount of time?_____

What was your feeling about the length of this lesson?

Too long_____ Too short_____ About right_____

Did you normally teach one activity per day or more than one per day?

General Comments on Lesson (cont.)

Are there any long-term follow-up activities which you see as a natural outgrowth of the lesson (e.g., computation-related activities, etc.)?

Appendix 5

A DESCRIPTION OF THE REVISED VERSION OF THE

MEASUREMENT OF WEIGHT UNIT

The Measurement of Weight Unit consists of two books which are to be used sequentially. The books develop concepts related to the measurement of weight by beginning with the weight comparatives. Instruction then progresses to the recognition of the common tools and units of measurement. In addition, an introduction to skills involved in the measurement of weight is provided. The major focus of each book, along with a summary of each of the lessons, is provided below:

Book One

Book One of the Weight Unit presents the comparatives of weight, stressing the process of identification and utilization. There are 5 lessons in this book.

The book begins by presenting the comparatives of weight, with emphasis placed on the identification of instances of each term. Instruction then progresses to the utilization of the comparatives to describe the relative weights of two or more objects. Book One concludes with a lesson on the balance. This lesson provides a review of all the weight comparatives and introducing a beginning tool of measurement.

Lesson 1: "Heavy and Light"

Vocabulary Words: HEAVY, LIGHT

The children are introduced to the basic comparatives of weight - "heavy" and "light."

Lesson 2: "Heavier and Heaviest"

Vocabulary Words: HEAVIER, HEAVIEST

The children are taught the comparative "heavier" as a general comparative of weight and introduced to the term "heaviest."

Lesson 3: "Lighter and Lightest"

Vocabulary Words: LIGHTER, LIGHTEST

The children are taught identification and demonstration of "lighter" as a general comparative of weight. In addition, they are introduced to the term "lighest."

Lesson 4: "Which One is Heavier"

Vocabulary Words: HEAVIER, LIGHER, SAME (as heavy as)

This lesson provides a review for the children of the comparatives "heavier" and "lighter" and introduces them to the concept of the "same" weight. The children are taught to make relative comparisons using these labels.

Lesson 5: "The Balance"

Vocabulary Words: BALANCE, (balancing, balanced)

The children are taught to identify a balance and to use a balance to compare the weights of two objects.

Book Two

Book Two of the Weight Unit deals with the scale as the basic tool for measuring weight, and with several units of weight measurement (pound, ounce, ton). Beginning weight skills are introduced in relation to the pound unit of weight. There are 6 lessons in this book.

The book begins with an introduction of the scale and its function and presents three units of weight - the pound , the ounce, and the ton. The major focus of Book Two is on the pound unit and on the skill of weighing in pounds using a bathroom scale. The ounce and ton units are also related to the pound so that the children acquire a general understanding of the relative weights of these units.

Prerequisite instruction related to the skills of weighing in ounces or in pounds and ounces, using scales other than the bathroom scale, is also provided so that follow-up instruction on these skills may be presented.

Lesson 1: "Scales"

Vocabulary Words: SCALE, WEIGH, (weight)

The children are taught recognition and labeling of common scales and to understand that a scale is used to weigh things.

Lesson 2: "How Much Does It Weigh?"

Vocabulary Words : POUNDS, (pound), (weight)

The children are taught that most things are weighed in pounds.

Lesson 3: "Weighing Things"

Vocabulary Words: POUNDS, (weight, weighing)

The children are taught how to weigh objects in pounds on a bathroom scale.

Lesson 4: "Ounces"

Vocabulary Word: OUNCES

The children are taught a second standard of weight - the "ounce" - and how to weigh objects in ounces. In addition, they are taught that 16 ounces is the same as one pound.

Lesson 5: "Pounds and Ounces"

Vocabulary Words: POUNDS AND OUNCES

The children are taught how to measure accurately in pounds and ounces (this is a supplementary lesson).

Lesson 6: "Tons"

Vocabulary Word: TONS

The children are taught that the ton is also a unit of weight.

## Appendix 6

## REVISED WEIGHT UNIT TESTS

The revised Weight Unit tests included a Skills Test and an Expressive Vocabulary Test. The Weight Skills Test was a 13-- item test designed to evaluate the child's skills related to the measurement of weight. The test consisted of three subtests, each of which evaluated a specific skill area: 1) Comparatives, 2) Balance and Scale, and 3) Units of Weight. The Weight Expressive Vocabulary Test was a 14-- item test designed primarily to assess the child's ability to utilize specific vocabulary words. This test consisted of three subtests which corresponded to the three subtests of the Weight Skills Test. Both tests were designed to be individually administered.

SKILLS TEST

Weight Unit

SUBTEST #1 - Comparatives

1. Identify heavy

| DO: Show picture J | |
|---|---|
| SAY: Look at all the things on this page and pretend that they are real. Find the things that you think are heavy and point to them for me. | PROMPT: If necessary repeat, point to all the heavy things. Before asking item #2 ASK: Can you find anything else that is heavy. |
| Scoring: For an acceptable response, the student must point to the 3 heavy objects (and none of the light objects). | |

2. Identify light

| DO: Remove the pencil, rubber band and paper clip from envelope. | |
|---|---|
| SAY: See this pencil; rubber band, and paper clip. Are these things heavy or light? | PROMPT: If necessary repeat: are these things heavy or light? |
| Scoring: The only acceptable response is the student stating light. | |

3. Identify heavier

| DO: Hand student the two canvas bags labeled X and Y. | |
|---|---|
| SAY: Which one of these two bags is heavier. | PROMPT: Which bag is heavier. ASK: What could you do to see which bag is heavier? |
| Scoring: For an acceptable response, the student must select the bag labled X as the heavier. | |

SKILLS TEST

Weight Unit

SUBTEST #2 - Balance and Scale

1. Identify lighter

| DO: Show picture K | |
|---|---|
| SAY: Look at the things on this balance. Which is lighter, the pencil or the pen? | PROMPT: If necessary repeat; show me which is lighter -- the pencil or the pen. |
| Scoring: For an acceptable response, the student must indicate the pen. | |

2. Demonstrate as heavy as

| DO: Place a balance scale in front of student and SAY: This scale is balanced because both sides are about even. DO: Put magic marker in one tray. | |
|---|---|
| SAY: Right now this side is heavier (indicate tray with marker). I want you to take these (give child pencils) and make it so this side (indicate empty tray) is as heavy as this side. | PROMPT: If necessary, repeat question. |
| Scoring: For an acceptable response, the student must place the pencils in the empty tray to balance the scale. Encourage the child to keep at it if he seems to have the concept. | |

3. Function of balance scale

| DO: Show picture L | |
|---|---|
| SAY: This box (point out) weighs 5 pounds. What does this stack of boxes weigh? (point out) | PROMPT: Repeat question. |
| Scoring: The child must say 5 lbs. or "the same" to be correct. | |

4. Match scale to function

| DO: Place in front of child picture M. Have cards N, O, P, & Q handy. Name each picture. | |
|---|---|
| SAY: Take these pictures and put them on top of the scale that you would use to weigh them. | PROMPT: Point to the scale that you would use to find out how heavy each of these things are. |
| Scoring: For an acceptable response, the student must indicate the one or both of the bathroom scales for the people and the scales with ounces for the candy and paper clip. | |

# SKILLS TEST

## Weight Unit

SUBTEST #3 - Units of Weight

1. Identify one pound (on a scale)

| DO: Show 3 pictures labeled R, S, T. Place on table, facing child, with card R on your right. | |
|---|---|
| SAY: Look at the pictures of these scales very carefully. Which one of these scales has a rock on it that weighs 1 pound? | PROMPT: Which scale shows a rock that weighs 1 pound. |
| Scoring: For an acceptable response, the student must indicate picture T. | |

2. Identify X ounces (on a scale)

| DO: Use the same display of pictures as used in #1 (R, S, T). | |
|---|---|
| SAY: Now, which one of these scales has a rock on it that weighs about 7 ounces? | PROMPT: Which scale shows a rock that weighs 7 ounces. |
| Scoring: For an acceptable response, the student must indicate picture R. | |

3. Identify heavier than X pounds (on a scale)

| DO: Show 3 pictures labeled U, V, W. (Place picture U on your right.) | |
|---|---|
| SAY: Which one is heavier than 20 pounds? | PROMPT: Which weighs more than 20 pounds? Which scale shows a box weighing more than 20 pounds? |
| Scoring: For an acceptable response, the student must indicate picture V. | |

4. Relative weight (pound)

| DO: Remove all pictures. | |
|---|---|
| SAY: Which is heavier -- one pound or five ounces? | PROMPT: If necessary repeat question. |
| Scoring: For an acceptable response, the student must state one pound. | |

5. Fact/16 ounces in one pound

| DO NOT show any pictures | |
|---|---|
| SAY: How many ounces are the same as one pound? | PROMPT: How many ounces are there in one pound? |
| Scoring: For an acceptable response, the student need only state 16. | |

6. Identify ton (related to heavy)

| DO: Show picture X. | |
|---|---|
| SAY: One of these ships is real, the other one is a toy. This ship weighs 3 tons, this ship weighs 3 pounds. Which ship is the toy. | PROMPT: If necessary, repeat question. |
| Scoring: For an acceptable response, the student must indicate the real ship. | |

# EXPRESSIVE VOCABULARY TEST

## Weight Unit

SUBTEST #1 - Comparatives (utilization)

1. Heavy

| DO: HINT: When desk is not appropriate in question, substitute table, bookcase. | |
|---|---|
| SAY: It is very hard for me to lift this desk - so would we say this desk is light? ["No"] No, if it's not light what is it? | PROMPT: If the student responds, "it is not light" ASK: How else can you say that the desk is not light? |
| Scoring: For an acceptable response, the student must state heavy. | |

2. Heaviest

| DO: Show picture A | |
|---|---|
| SAY: These animals are in a line because of how heavy they are. This hippo [point out hippo] is heavier than all the other animals, so we can say that the hippo is the _____. | PROMPT: What's the special word we can use when something is heavier than everything else. If child answers "heavy" say: Can I say it is the lightest? (no) What can I say? |
| Scoring: For an acceptable response, the student must state heaviest. | |

3. Lighter

| DO: Remove all pictures. | |
|---|---|
| SAY: Is this pencil (or pen) heavier than this chair? No, if the pencil's not heavier, what is it? | PROMPT: If the pencil's not heavier than the chair then it is _____. |
| Scoring: For an acceptable response, the student must state lighter. | |

EXPRESSIVE VOCABULARY TEST

Weight Unit

SUBTEST #2 - Balance and Scale (utilization)

1. Scale

| DO: Show picture B | |
|---|---|
| SAY: What is this? | PROMPT: |
| Scoring: For an acceptable response, the student must state scale. | |

2. Definition Scale

| DO: Remove pictures | |
|---|---|
| SAY: What do we use a scale for? | PROMPT: If necessary, repeat question. |
| Scoring: Acceptable responses include: to weigh things or to find out how heavy things are. | |

3. Balance

| DO: Show picture C | |
|---|---|
| SAY: What's this called? | PROMPT: This is a special kind of scale. What is its special name? or We don't usually call this a scale. What do we call it? Or what kind of scale is this? |
| Scoring: For an acceptable response, the student must state balance. | |

4. Heavier than

| DO: Show picture D | |
|---|---|
| SAY: Look how much the comb and baseball weigh. What can you tell me about the baseball? | PROMPT: The baseball is what than the comb? |
| Scoring: For an acceptable response, the student must use the phrase heavier than in an appropriate context (e.g., the baseball is heavier than the comb). | |

5. As heavy as

| DO: Show picture E | |
|---|---|
| SAY: Look at how much the apple and pear weigh. What can you tell me about the apple and the pear? | PROMPT: How heavy is the apple? If student says 'same' ASK; How are they the same? |
| Scoring: For acceptable responses, the student may say they are the same or the apple is as heavy as the pear. | |

6. Weigh (define)

| DO: Remove all pictures | |
|---|---|
| SAY: Why do you weigh things? | PROMPT: What do you do when you weigh something |
| Scoring: For an acceptable response, the student may "to find out how heavy or light things are." | |

EXPRESSIVE VOCABULARY TEST

Weight Unit

SUBTEST #3 - Pounds and ounces (utilization)

1. Pounds

DO NOT show any pictures.

| SAY: About how much do you think I weigh? | PROMPT: Take a guess, I weigh about 100 what? 100 _____ |
|---|---|
| Scoring: Record student's exact response. Also record all prompts used. | |

2. 1 lb.

DO: Show picture F

| SAY: What does this say? | PROMPT: What does it mean? What's another way of saying 1 '1', 'b'. NOTE: Be sure you repeat exactly what the child said 1 '1', 'b', repeat it that way. |
|---|---|
| Scoring: For an acceptable response, the student must state the complete phrase one pound. | |

3. Relate pound to balance

DO: Show picture G

| SAY: Look at this balance scale -- it's balanced. I know that all the pencils weigh one pound -- how much does the bone weigh? | PROMPT: If the pencils weigh one pound -- how much does the bone weigh? |
|---|---|
| Scoring: For an acceptable response, the student must state one pound. | |

4. Ounces

| DO: Show picture H | |
|---|---|
| SAY: Look at the rock on this scale. About how much does this rock weigh? | PROMPT: If necessary, repeat question. |
| Scoring: For an acceptable response, the student must state _____ ounces. | |

5. 20 oz.

| DO: Show picture I | |
|---|---|
| SAY: What does this say? | PROMPT: If students say 20 'o', 'z', ASK: What's another way we can say 20 'o', 'z'. |
| Scoring: For an acceptable response, the student must state twenty ounces. | |

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